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A NEW METHOD FOR THE PURIFICATION OF WATER SUPPLIES.[1]

By Dr. George T. Moore.

At the time I accepted the invitation to speak before the American Philosophical Society, the method devised in the Laboratory of Plant Physiology for the purification of water, the work upon which has been so ably supported and advocated by Drs. Galloway and Woods, of the Bureau of Plant Industry, had not received the notice in the public press which has since been given it, and I fear that many of you will be disappointed if you have come this evening with the idea of hearing anything spectacular or startling concerning the subject. It will be difficult for me to say anything particularly new after the very thorough discussion which has been carried on by the newspapers in your city and elsewhere, and whereas I once might have hoped to interest you by the novelty of the method and its results, about all I can now expect to accomplish is to give you a statement of the facts as they have developed. Perhaps the best way to bring the subject before you is to outline briefly the history of the work as it has been carried on during the last four or five years.

While teaching in New England, I frequently had called to my attention cases of water reservoirs which, because of the profuse growth of certain plants, had been rendered unfit for use. Those of you who have had any experience with water of this kind know how disagreeable it can become, and until recently

[1] An address given before the American Philosophical Society, Friday evening, October 21, 1904.

the situation was complicated by the fact that absolutely no efficient remedy for the condition was known. The plants responsible for this bad odor and taste in the water are for the most part confined to a group known as the Algæ, and are among those forms popularly known as "pond scum," "green scum," etc., which occur so abundantly in stagnant pools during the warmer months of the year. While in some instances the disagreeable odor is due to the death of these organisms and consequent decomposition, this is by no means the only way in which these plants affect the water. Very many of the blue-green algæ, together with certain other more or less closely related forms, have the power of liberating an oil which is comparable to one of the aromatic series, a very small quantity being sufficient to affect a large amount of water. The odor and taste of these oils is variously described by different consumers, but in no case is it any addition to a drinking water, and at times the odor becomes so strong as to make it almost impossible to use the water for sprinkling the streets and lawns, to say nothing of domestic use. Up to the present time only the most general methods have been resorted to to prevent the growth of these algæ in water supplies. The problem has been one which frequently confronted the water engineer, but, although many costly experiments have been carried on, the results in almost every instance have failed to accomplish what was desired. One of the favorite recommendations made to water companies for difficulty with algæ was to cover the reservoirs. Since most of the algæ require light for their development, this was a very logical recommendation, but unfortunately the expense and inconvenience of constructing a permanent cover for most reservoirs is almost prohibitive, and there have been very few water companies in this country which have even made the attempt to exclude the algæ in this way. Another precaution which of late years has been almost universally practised in endeavoring to keep the source of supply and reservoir free from algal growth is to carefully remove as much of the organic matter as possible, which will in time be in contact with the water. Naturally, when new reservoirs are being constructed every precaution should be taken to prevent the presence of any more organic matter than is necessary, as this only serves to increase the nutritive value of the water, and consequently the algæ flourish more readily. In this connection it should be borne in mind that even though reser-

voirs are carefully constructed and the majority of the organic matter excluded by concreting the reservoir, there is even then a strong possibility of the water being rendered unfit for use by the presence of these obnoxious plants. Filtered water is more subject to algal pollution than surface water, because any water passing through a considerable layer of sand is apt to pick up certain nutrient salts which enable the water to sustain algal life in larger proportions than it would otherwise do. Still another method supposed to prevent contamination by algæ is that of pumping air into the water, or aerating it by means of some sort of spraying apparatus. Unfortunately, however, many of the unicellular algæ are able to multiply more rapidly with a plentiful supply of air than without it, and for this reason aerated water has been known to give rise to serious algal growth when it would otherwise have been unable to sustain the life of these plants in any considerable quantity. In certain parts of New England the conditions due to the presence of these plants are notorious, the trouble being very serious and the water frequently unfit for use a considerable part of the year. But the difficulty is by no means confined to this region, there being scarcely a State in the Union which has not reported serious difficulties of the same kind. Since the condition seemed to be one which called for some relief and none of the used methods were of more than partial benefit, it seemed advisable that the problem be taken up from an entirely new standpoint, and for this reason a series of investigations were undertaken for the purpose of gathering all the information possible in regard to the life history of the organisms, as well as the physiological effect of certain substances under laboratory conditions. A large number of substances were experimented with, and in a very short time it became evident that nothing was so toxic in high dilutions to these forms as certain of the heavy metals.

At about this time an opportunity presented itself for experimenting on a large scale in the cress beds of the South. Here the conditions were such that after the cress had been cut and before the new growth could start, a thick heavy mat of algæ would form over the surface of the water sufficient to prevent the growth, if not entirely smother out the delicate cress plants. Since water cress at that time of the year was worth about $20 a barrel, and the demand was considerably greater than the supply, a large amount of money

was being lost in this way, and it seemed worth while to experiment with these beds and see if it would not be possible to exterminate the algal growth without destroying the cress. Consequently, a solution of copper sulphate (this metal being used on account of its cheapness, it having been shown to be fully as efficient as any of the others) was prepared of a strength of about one to fifty million parts of water, and this was sprayed upon the algal mass in hopes that it would accomplish the desired result. While its use was fairly satisfactory, it was soon found that the method of application would have to be improved before any success could be attained, as only that part of the growth was destroyed which the spray was able to reach, and the algæ within the center of the mass or some distance under the surface remained uninjured. The method was then tried of adding directly to the cress beds a sufficient amount af copper sulphate crystals to make a solution of about the same strength, and this gave almost immediately most satisfactory results. In a very short time all of the algal growth was exterminated, and although the first application was made in the fall of 1901, it has never been necessary to apply copper more than once a year to these beds. Naturally, the degree of success attained in this work, while not in any way demonstrating that a similar method would be efficacious in large reservoirs, seemed to warrant a more thorough investigation of the subject, and for this reason a large series of tests was inaugurated calculated to demonstrate the toxicity of copper upon most of the common polluting algæ which occur in these supplies. It was soon found that the toxicity varied very greatly for the different plants, and that no universal strength of solution could be used which would result in the extermination of all forms. However, the dilution necessary to kill any of these algæ was so high that it seemed to offer by far the most promising remedy which had ever been devised. Of course, in hoping to perfect any method of this kind, it was necessary that the question of efficiency, cost and harmlessness to man be kept prominently in mind. In regard to the first point, no amount of laboratory demonstration is equal to the practical application of a method on a large scale. For this reason, while it might be very interesting to give you the results of a long series of experiments conducted on different organisms for the purpose of determining their death points in dilute solutions of copper sulphate, I am sure it would be more con-

vincing to give you briefly the results of the treatments of a very few of a considerable number of water supplies which have either been treated under our direction or as a result of the experiments and information given out by the Department of Agriculture.

In June, 1903, our attention was called to the condition of the reservoir at Winchester, Ky. This supply was constructed in 1890, and after the first three years a strong odor and taste was noticeable in the water during the hot summer months. This condition gradually increased until the water attained such a degree of offensiveness as to make its use for any purpose almost intolerable. Aeration and mechanical filtration were tried without effect, and it seemed that the only hope for relief was to abandon the entire reservoir and go ten miles to the Kentucky River for the source of a new supply. The cost, however, was too great to be considered, and for this reason the difficulty was considerably increased. A microscopical examination of the water showed that the odor and taste was due to the presence of one of the blue-green algæ, and it was believed that the application of copper sulphate at the rate of about 1 to 5,000,000 would be sufficient to destroy these forms; consequently, there being no objection on the part of either the water board or the health authorities, a treatment was made, and the results have been everything that could be desired. Within three or four days the odor disappeared and the water was perfectly clear. This summer at about the same time it was feared that the algal growth was reappearing, and for this reason another slight treatment was made, but with this exception no copper has been added to the water since the original treatment in June, 1903, and it has remained perfectly clean and sweet.

In 1892 the Butte (Mont.) City Water Company began the construction of a large impounding reservoir for the purpose of storing the water of a mountain stream, having its source in the summit of the Rocky Mountains. The next year the stored water became badly contaminated and was unfit for domestic use on account of its disagreeable odor and taste. In 1894 the dam was increased so that the capacity of the reservoir was 180,000,000 gallons, but the same trouble was experienced as during the previous year, and further work was stopped on the dam until some remedy could be discovered. An extensive study of the conditions to discover the cause and find a remedy for the trouble was undertaken, and, besides a

resident chemist and bacteriologist, consultations were held with water engineers of note in all parts of the country. It was finally decided to increase the water supply flowing into the reservoir and more thoroughly clean the bottom of all organic matter which might contain vegetable organisms. Notwithstanding the efforts made in this line, the water was so infected with algæ as to be absolutely nauseating in odor and taste, and it became so offensive that the odor was continually present in the city on account of the water being used in sprinkling carts. On July 7th of this year copper sulphate was added to this reservoir in the proportion of 1 part to 8,500,000 parts of water. During the first twenty-four hours the water in the reservoir gave off a most pronounced and disagreeable odor, and at the end of the second and third days changes were noticed in the color and taste of the water, particularly in the lower depths. By the end of the fifth day the water assumed a natural color and only a slight odor and taste was noticeable on the surface. On Sunday, July 24th, the water in the reservoir being absolutely pure, for the first time in ten years, during the summer months, was turned into the city mains, and since this date has been in constant use.

Without giving the details of other experiments, perhaps it would be sufficient to read a few of the reports from water engineers and superintendents who have used the copper sulphate method in this country.

From C. T. Hawley, Secretary of the Cambridge (N. Y.) Water Works Company: "The use of copper sulphate has certainly been most successful in our case. Not only has the Water Company been saved the considerable cost of the repeated cleaning of the reservoir, but the residents of our village have been saved the annoyance of having at times to use a most unsatisfactory water supply."

Proctor & Gamble Company, Ivorydale, O.: "We are much pleased with the result, and thank you for your kind and prompt advice."

Anton Hardt, Wollsboro, Pa.: "Soon after the application of sulphate of copper the algæ disappeared and with them the disagreeable odor, and the water has been palatable ever since. I wish to express this company's gratitude to your department for prompt and efficient action in this case and have to say the application of this method will be of great service to water systems."

J. A. W. Brubaker, Secretary of the Millersburg Home Water Company, Millersburg, Pa.: "Enclosed you will find a statement in the matter of the extermination of algæ. This experiment was made by the Millersburg Home Water Water Company, and the results are very satisfactory."

A. W. Harris, Director of the Jacob Tome Institute, Port Deposit, Md.: "I am writing now to say that the improvement in the taste and odor of the reservoir water was extremely marked, and the trustees have expressed themselves as very much pleased with the result of the experiment. The water is now in a very satisfactory condition, and it seems to us your discovery is likely to prove of great importance. We shall always feel grateful for having known of it."

Alfred M. Quick, Engineer Water Board, Baltimore, Md.: "I have completed the experiment of treating the water in Lake Clifton with copper sulphate to eliminate the algæ, and am glad to say the result has been an unqualified success."

These, with other cases which have been referred to in the Philadelphia press, seem to me sufficient to establish the question in regard to the efficiency of the method for the removal of algæ. It might also be considered as having answered the question of harmlessness to men, since in many of these cases the water was not cut out of service for an instant, but the consumer was supplied with the copper-treated water in the same quantity and way that the algal polluted water was furnished. Of course, a great deal might be said in regard to the effect of copper upon the human system, and there is a large amount of evidence to show that by actual test this metal is not as poisonous as it is popularly supposed to be. Without attempting to review the literature upon the subject or give you a list of the considerable number of experiments which have been carried on by investigators who have eaten large quantities of copper for more than a year at a time, it probably is sufficient to say that there does not exist an authentic case of copper poisoning. This may seem surprising, but a careful investigation of the facts will, I am sure, demonstrate the correctness of this statement. While it is true that there are many so-called cases of copper poisoning, and the popular belief in the deleterious effect of this metal upon the human system is very strongly established, the fact still remains that all of the so-called cases of copper poisoning are due to other things, and the bad effects ascribed to copper have

been due to causes not generally recognized at the time. I am aware that this is a point upon which the experts disagree, and about as many men can be found who will claim that copper is a poison as those who maintain that it is innocuous. It seems to me, however, that under the circumstances, since those who are supposed to know cannot agree upon this point, that we are justified in taking what might be termed the evidence of experience, and basing our conclusions upon this. The very well-known fact that copper is contained in proportionately considerable quantities in a good many ingredients of our daily food, and that this amount of copper, while sometimes added artificially, is often naturally present, should lead us to the conclusion that certainly these infinitesimal amounts are not harmful. The decision of the English judge in the case of prosecuting a dealer for using copper in greening vegetables is worthy of note. Being somewhat bewildered by the large amount of testimony, the experts on both sides were able to produce, proving definitely both the poisonous and harmless nature of this metal, he based his decision upon the fact that in a market which had been selling these greened peas for thirty-six years, and had now reached a number of about 20,000,000 cans a year, the prosecution were unable to bring forward a single case of sickness or injury which could be traced even in the remotest way to the use of these vegetables. A can of these peas, by the way, contains several hundred times more copper than would ever be used in the treatment of a water supply.

If within the last four or five months over fifty water supplies throughout the country, with reservoirs varying from a few to hundreds of millions of gallons, and which for years have been rendered unfit for use because of algal pollution, can be successfully cleared up with one or two applications of copper sulphate at a dilution of from one to fifty million, it seems to me that we are justified in believing that the method is efficient, and accomplishes something which, until it was introduced, has been considered one of the unsolved problems in water supply work. Whether it is harmless or not I will not discuss further. This is a question which must be decided by the authorities of each community, and, of course, if there is any doubt on the subject, the method should not be used. It does seem strange, however, that there should be any objection to the possibility of taking into the system a substance

which is daily being used in quantities a hundred times greater, and without any harmful results so far as is known. The fact that the copper rapidly disappears from most waters, and that at least 10 per cent. of it is immediately absorbed by the algæ and becomes insoluble, need not be taken into account, although it, of course, tends to make the method more secure for those who have objections to the presence of copper in food or drink, when they know it is there.

Very naturally after it was noted that the algæ were so susceptible to infinitesimal quantities of copper, it seemed worth while to test the effect of this metal upon typhoid and cholera germs, these being the two pathogenic forms which are most commonly conveyed by water. As the result of some 500 or 600 experiments, it was demonstrated that, while these bacteria were not as sensitive as the algæ, still the dilution necessary to produce death was sufficiently great to warrant the belief that under certain conditions efficient sterilization of large bodies of water could be brought about. It should be stated most emphatically and clearly understood that it was not supposed for a moment that such a method could be substituted for efficient sand filtration or any other means now in use which has been demonstrated as doing the work thoroughly. It was believed, however, and practical tests since made have proved it, that in cases where no system of filtration existed, or where the filter failed, owing to the storage basin being flooded by surface drainage, or because of leakage or other cause, this method was not efficient, that in copper sulphate we had the only remedy for such emergency cases. It should be borne in mind that nothing is more delicate or requires more intelligent and conscientious supervision than a filter plant. Any one who has had an opportunity to visit many such plants throughout the country and really knowing their inside workings, as it were, cannot help being astonished at the low rate of efficiency frequently maintained. Consequently, the application of copper sulphate under such circumstances for the purpose of reducing the bacteriological content has been used successfully in enough cases to demonstrate that it has a distinct place in water purification. So far as I know, its use has been resorted to for but a short time, or until the source of pollution could be removed. Whether it would be efficient and proper to use it continuously during a considerable period awaiting

the completion of a filtration system, is a question to be decided by the conditions governing the case. There is no doubt in my own mind that under certain circumstances such use would be justified, and the results would more than repay any outlay of money and labor.

It should be remembered that it is not a question of an efficiently filtered water as compared with a water containing a minute quantity of copper, but it is a typhoid or algæ-laden water versus copper water. Some of you may object to the use of small quantities of preservatives in meat, but if it is a question of preserved meat or decayed meat until the new supply arrives, I do not think you would hesitate very long. The use of copper for the removal of algæ and bacteria is necessarily a remedy, and each water supply requires a special prescription according to the various conditions involved.

In one case where copper was used for the purpose of destroying the algæ, the bacteria were reduced 95 per cent., and while sewage bacteria were found before treatment, they disappeared entirely afterwards. In another case where a large storage reservoir was flooded, owing to the breaking of a levee, the bacteria were reduced from over 5,000 per cubic centimetre to less than 50 per cubic centimetre. Again, in the case of a spring which was accidentally polluted, and which gave rise to over fifty cases of typhoid in less than a week, the use of copper completely sterilized the water, and it was possible to continue using the spring within five hours.

Since the use of copper for the destruction of typhoid and cholera has been more prominently brought before the public, a number of most interesting cases have been called to my attention, which seem to add considerable weight to the laboratory or experimental side of the question. Many of these have already been referred to in the press, but the fact that certain communities have for centuries used water from copper vessels to avoid cholera, that workers with copper are popularly recognized as being immune to this disease, that the use of copper sulphate in Indianapolis years ago effectively stamped out cholera—all of these facts with many others are, it seems to me, worthy of consideration, even though they require careful scientific investigation to make them of value.

The question of the use of copper in medicine is one I cannot discuss, although I should like to. It is daily being used in quantities so much greater than would ever be added to a water supply,

that many physicians evidently do not consider it as poisonous as it is supposed to be. When we remember that copper in water is 100 times more efficient as a germicide than carbolic acid, fifteen or twenty times more than formalin, and, in fact, nothing is known which, when free from organic matter, is so deadly to germs and harmless to man, it certainly seems that the beneficial results obtained by the physician are easily explained.

In conclusion, then, I would say that in spite of a considerable number of articles appearing which seem to clearly demonstrate that copper in such small quantities will not destroy algæ and certain pathogenic bacteria, the fact remains that it has been done and is being done in millions of gallons of water in various parts of the country. It is like the old arguments against the Atlantic cable, or the treatise carried by the "Great Eastern" on her first trip, scientifically demonstrating the impossibility of such a ship crossing the ocean. It is also interesting to note that without exception the amount of copper necessary to produce death of both algæ and bacteria in a large reservoir has always been less than the theoretical amount determined in the laboratory by the use of aquaria and test tubes.

It is probable that there will always be a certain amount of opposition to the use of copper for the purification of water just as there is to vaccination or antitoxine, but as more and more cases are added to the list of supplies successfully treated without harm to the consumer, this aspect of the question will disappear. This is well illustrated by the attitude of the French Government which originally maintained such rigid laws against the use of copper in canned goods and otherwise, but as the Prefecture of Police of Paris recently wrote:

"Up to the year 1899 the subject of the possible bad effects on the health of the people by the introduction of sulphate of copper in the preparation of preserved vegetables had not been so much studied as it has of late, the scientific opinion being divided. But since that time the Consulting Committee has been renewed, and has again taken up the question and passed on the experiments made by private parties both as to the quantity of copper that the human body can consume without danger to health, as well as the proposition that the various preserved foods that are colored green may contain. From these experiments they came to the conclusion

that there was no longer any reason to oppose the system of greening preserved vegetables by means of the salts of copper."

Consequently it is now allowable in France to use salts of copper for preserving the green color in food products in any amount, although until the harmlessness of this metal became known it was forbidden to even use a copper vessel for preserving purposes.

PHARMACY AND CHEMISTRY AT THE WORLD'S FAIR.

By Carl G. Hinrichs, Ph.C.,
Professor of Chemistry, Marion-Sims Dental College.

(*Continued from p. 531.*)

VI. GERMANY: CIVILIZED AND UNCIVILIZED.

When the readers see this the great Louisiana Purchase Exposition will be a thing of the past. It will ever be kept green in minds of the millions that attended, by pleasant memories of pike, of grand palaces and of magnificent displays of the wonders of nature and the handiwork of man. To those who come after us, it will probably be known as the exposition of the grand prize. As a visitor during the last month of the fair, it seems that this highest award has been bestowed on a most lavish scale. We find exhibitors in the same lines who each boast of this highest honor, while many have an array of gold medals to set off the parchment.

Entering Germany's chemical exhibit, we find that it is not without its full quota of these mementos; in fact, to use a familiar expression, they may be said to be "it." At least thirty-three grand prizes have been decreed to our Saxon brethren for superiority in this field alone by the superior jury. Of gold medals they receive thirty-one; the number of minor prizes need not be mentioned.

Germany, in the pharmaceutical and chemical lines, cannot be said to make a commercial display; in fact, they themselves make no pretensions in this line, for the big firms cared not to go to another great expense so soon after the Paris Exposition, especially as the high tariff is a bar to the successful exploitation of many chemical goods of strict commercial value in the United States.

The underlying idea of the Germans to make at this exposition an *Unterrichts Ausstellung* has been carried out with a certain degree of success. This method naturally brings to the mind the idea of a

systematic arrangement of the objects displayed. But there are many articles that do not lend themselves to this mode of display; the so-called systematic in practice often proves a failure. So we need not be surprised that many features had an unrivalled success; others had all the ginger taken out of them by the attempted systematic arrangement, due to an overdoing of the otherwise excellent idea. It is especially in the exhibit of chemicals that this systematic arrangement was applied to an excess. Chemicals are used in many forms, in many industries and for many purposes. Can we wonder that chemists did not care to linger at their display of chemicals? Will a modern specialist hunt up what may be interesting to him from out of thousands of compounds shown? Experience is our guide; chemists did not stay and study the chemical display hours at a time, but simply glanced here and there and passed on.

Theorie und Praxis are very often found not to go together very well. The wonderful products of German thought and skill are often found to be in very queer company; a highly important chemical of recent date is often associated with a purely technical article Americans make on a large scale. Do we not lose the idea of importance of a discovery or, vice versa, of the technical article by this association? Surely what Germany produces by the millions of pounds annually will appeal more strongly to some chemists than that which was only made once and that sample now before you. Indeed, when you come right down to the first principles o' inorganic chemistry, is not a study of metals, bodies having many points in common, but differing by slight variations in malleability, lustre, color, ease of production from ores, insolubility, etc., more easily studied and learnt than when these same metals are thrust upon you unassociated with their kind? Is it not the acid radical that gives a salt its true chemical character, which is modified gradually step by step as we have another metal in combination therewith? What would one think of a man that, treating of a hydrocarbon in organic chemistry, follows this with all the derivatives, ethers, etc., in which that same radical may enter? The latter may do for a dictionary, but hardly for an *Unterrichts Ausstellung*.

In spite of the heterogeneous nature of the German systematists' attempt, here and there an article may be found that is important medicinally or shown to us under a new garb of purity and strength. We detected a number of colloïdal metals, such as col-

loidal gold and silver, which lend themselves to antiseptic treatments. Peroxide of hydrogen as a thick syrupy liquid, 100 per cent. in strength. This is a product made by the gentleman who has studied peroxide for twenty years. We all know that we can make granulated salts of fine appearance if we stir a hot concentrated solution as it cools. The Germans are now making many salts of reasonable sized uniform crystals by gradually cooling a slowly moving hot concentrated solution of the salt. A jar of fine alum crystals of this kind is shown. Winkler's germanium exhibit, process for making sulphuric acid and his other technical feats were rewarded by a grand prize.

In this same room we see the many apparatus used in the study of inorganic chemistry. A wealth of fine graduated ware, thermometers, gas analysis appliances, Jena glassware, royal porcelain goods. These take up room, they do not hide themselves; as a result many study this feature of the exhibit thoroughly. It is a decided hit.

In the organic chemistry division the thousands of dyes that have made Germany famous, or infamous when wrongly applied, are shown in large array. A case of some 500 compounds shows, for a wonder, the historical development of the industry.

The many beautiful and large samples of ceresin and of other natural hydrocarbons contrast strongly with the artificial like compounds, derived from fish oil and various vegetable oils. The Standard Oil Company need fear no competition from this source.

Looking at the caffein, theobromine and like products indicating the steps taken from the uric acid furnished so liberally by our feathered friends, the sea birds, a fear that some day we may sip a cup of coffee or cocoa that originally traced its ancestry to the manure piles of the Pacific, is not altogether a pleasant one.

Fortunately all alkaloids come under one head, so that the whole branch is displayed in a single case. The many decomposition products, commonly called Abbau-Produkte, of the alkaloids that helped chemists to study their constitution and incidentally make them artificially, are instructive.

Synthetic perfumes and essences that vie with the natural odors are many. Jonon, jasmin, rose and the like are in pint bottles, a mere sniff at the stopper shows the fine quality of these products.

In this room we find the many aids used to-day by the synthetic

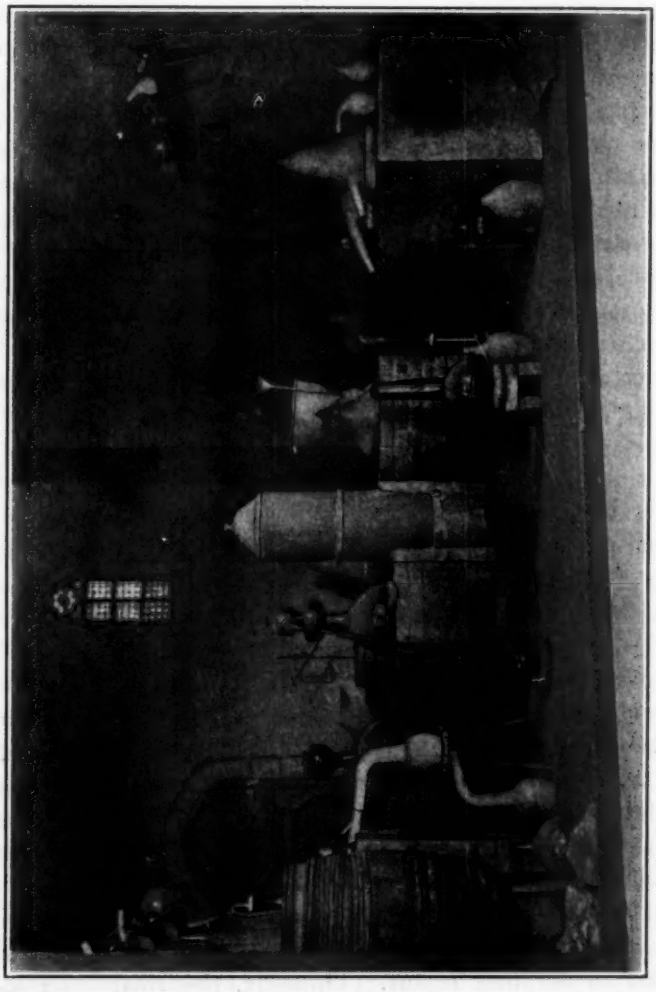
chemist; electric and gas combustion furnaces, vacuum-distilling apparatus, bombs, appliances for working under pressure and the like, also the many appliances used by the dye chemist and colorist to determine by actual experiment the value of the artificial dye product. The many samples of such dyed goods showing all the nuances of the rainbow, and these in fast colors, can be said to represent one industry of Germany in a manner worthy of its grand development.

Under physiological chemistry are found the many ferments, fermentation products, and also the synthetics. An especially interesting exhibit is the series of preparations showing the constitution of the fats, as determined by fermentation. Stearic acid, glycerin, palmitic acid and many others of high purity are prepared by fermentation at 37°. No decomposition products are found in these preparations that usually accompany those prepared by the classical chemical methods.

Buchner, who showed that the cell is not a necessity for fermentation, that the changes are not dependent on the life process, but follow laws of the inorganic chemistry, has a large display of the apparatus he used to grind the yeast with infusorial earth, he then expressed the juice with hydraulic power, thus obtaining a fluid containing the enzyme and no cells. The juice so expressed and shown is of a brownish red color; when dried it resembles yellow dextrin; the pure product obtained by precipitating with alcohol-ether is pure white.

At the main entrance to the exhibit is a large room devoted to the current chemical literature of Germany, such as *Chemiker Zeitung*, *Pharmaceutische Centralhalle*, etc. Also many works illustrating the advances made during the past 500 years in the chemical arts in the Fatherland. On the left is the office of Dr. Zwingenberger, who was a director of the extended electrochemical plant of Von Heyden, a firm well known to all pharmacists; the Germans did well in having a chemical representative in charge of the exhibit. Next to the office is the weird laboratory of the alchemist mentioned in our first report. Opposite, the small 15 x 20-foot exact duplicate of Liebig's Laboratory at Giessen—a room that to-day would hardly do for the assistant to a professor in one of the great State laboratories. Still Liebig did all that marvelous work on the radicals of organic chemistry in this small laboratory.

Taught the greatest chemists of the world in that small room, left the analysis of organic compounds by combustion so perfect that he said every fool can now do this work; at least this is the sense of his expression, as we would say it in Missouri. Going now to the

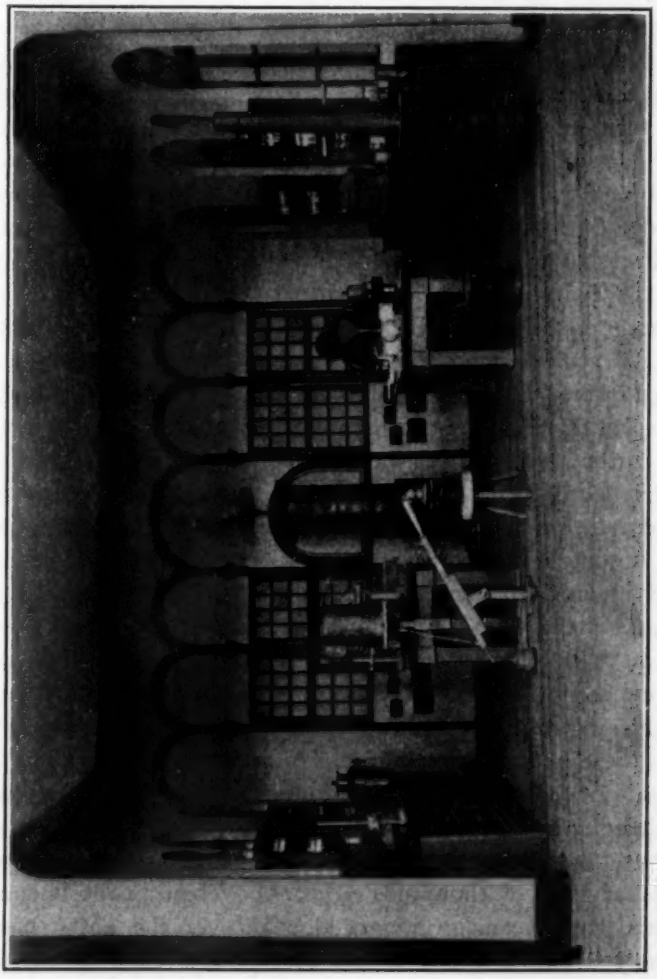


Alchemist's Laboratory.

Agriculture palace, we find the agricultural practice so lucidly portrayed by Liebig strongly exemplified in the display of Stassfurt salts.

In more ways than one it is a remarkable story that the Stass-

furt salt industry tells us, as may be read from the most excellent work on this industry by Dr. G. Krause.[1] Already in the days of the great Charlemagne, the region about the town of Stassfurt was



Liebig's Laboratory.

noted for its salt springs. Salt, common salt, was obtained from these waters by boiling down to crystallization. So important did this industry become in time that the landed owners and salt

[1] "Die Industrie von Stassfurt und Leopoldshall." Cöthen, 1877. The author is the founder of the greatest chemical paper of the world: *Chemiker Zeitung*.

boilers became nobles, always represented in the councils of state by one or more of their members. In those early and troublous times, the neighboring states could often use a little ready cash; now the people or the many always need the necessities of life; consequently, when tax measures are levied against the poor a golden stream flows into the coffers of the state. Accordingly, these states raised the duty on salt in many instances to an exorbitant degree, and, in turn, our industry flourished or languished.

That our salt boilers manufactured salt to some extent may be inferred from the fact that in 1776 the annual production amounted to 14,000,000 pounds. The times changed; the industry was sold to the Prussian crown for $75,000 in 1794. It proved a poor investment; 1815 witnessed no salt produced.

Science stepped in. Geologists began to reason that where salt springs of such extent continually flow from the earth, a very extended deposit of salt must exist in the immediate neighborhood. To prospect, borings were made in the thirties; in 1839 a strong flow of brine was struck. Remarkable result; it was unlike the pure, strong salt brine of the springs; it contained mainly magnesium chloride, was intensely bitter, while of salt a few per cent. was all that it could boast of.

In 1851 von Carnall supervised these works of the Prussian Government. Shafts were sunk down to the salt body. The deposit was found to be most extensive. In studying the deposit he found it to be composed of alternate layers of rock salt and anhydrite, conclusively showing that a periodical separation of the ocean's salts took place in these inland bays in prehistoric times. The influx of sea water did not dissolve the salt deposited by last year's flow, for the insoluble anhydrite protected the salt already separated. Geologists from these annual rings estimate the age of this salt deposit at upwards of tens of thousands of years. When finally it came to pass that the ocean no longer flowed over the entry bar, the immensely strong solution of the very soluble salts of the ocean separated and formed a coating of potash and magnesium salts on the salt proper. This colored deposit was at first looked upon as worthless; they were the *abraum-salze*, salts that must be removed to get at the valuable rock-salt.

It was not for long that these worthless colored salts were looked upon with anything but disgust. When a nuisance confronts the

miner he usually wants to know what it is; chemists showed the presence of much potassium in the abraum-salze. An immediate result was the building of many chemical factories about Stassfurt to utilize the seemingly worthless; indeed, this has proved the basis of much of Germany's boasted superiority as a center of chemical manufacture.

It was not alone the chemical industry that profited; what Washington called "the noblest calling of man," agriculture, profited more. With the modern intensive farming, the soil becomes impoverished; but the remarkable fact is that the United States Government has produced a bulletin the past year that knocks Liebig's teaching higher than a kite. As usual even the most radical statements of Liebig, denied by his most noted fellow-workers, are proved by time to be true. The necessity of potash in available form in the earth is not to-day denied. The discussion of the remarkable somersault of our Government chemist brought forth a lively discussion at the last December meeting of the Association for the Advancement of Science in St. Louis. No one went away with a feeling that the method of analysis of the Government chemist proved what he claimed. Liebig was right. Wheat requires potash; soils where none is found cannot produce a bumper crop. "*Ex nihilo nihil*," saith the alchemist, and Germany is not ashamed of him.

Coming back to kali, the German Government experiment stations show the marvelous effect of this fertilizer on various crops. One goes away with a feeling that chemistry is a noble science to enable us to bring forth more of the riches of the earth, to make two blades of grass grow where only one grew before. Examining the Kali Works exhibit, we see the cause—great blocks of colored salts showing all the formations of the region where they are obtained. In smaller glasses some exquisite samples of the many chemical individuals that have contributed so richly to modern chemical prowess of Imperial Germany.

Let us now pass to the uncivilized dependencies of Germany.

When the fever of colonial aggrandizement passed over the European powers, Germany was not backward in taking many valuable slices of the Dark Continent. All have an exit to the sea; the lands are under the broiling tropical sun. At present the outgo is greater than the revenue derived from these small empires. In the near future, when they make the negroes work, a different story

will be told. That these lands furnish some of the most desirable of tropical produce is finely demonstrated by the magnificent botanical display in the Palace of Education. In fact, it may be said that this is the "only" exhibit in this line on the grounds.

Togo lies next to that unruly negro kingdom of Ashanti. Their staff of life is furnished by the seeds of the various varieties of *Andropogon sorghum L.*, a plant favoring tropical climes, growing to a height of from 8 to 20 feet. The seed shown are from three varieties—about the size of a millet grain, of pure white color, of a rich orange and a fine cacao-red. These plants also grow in Ost-Africa, where the aborigines, not to be outdone by their Teuton masters, have for centuries brewed a beer, *merissa*, from these grains.

Cola acuminata is not so rich in caffein and theobromin as is the *Cola vera*. The brownish seed of both are found in a five-capsuled fruit, cacao-like, some 3 inches long by 1 inch in diameter. This cola is used largely in making liquors and medicinal tonics. In the neighboring Soudan it forms the drink. Chewed by the traveling natives, it sustains them on the often long and forced marches the couriers must make in those countries.

Butyrospermum Parkii yields a nut that much resembles a buckeye in size and form. The eye is white and more elliptical in shape; the body color is a fine pale brown. These seeds boiled with water yield the so-called shea butter, a bland fat of pale-green color that does not turn rancid.

At least six varieties of strophanthus are shown. Togo grows two—the *S. hispidus* and *S. sarmentosus*. The seed-pods and seeds of all are markedly different in size, shape and color. The twin-pods at almost right angles terminate a twig. Some are plump and a foot in length, others nearly 20 inches. The *S. hispidus* pod shown is about 18 inches long, at the base about ¾ inch in diameter, slowly tapering to a sharp point. The husk is of a darkish-brown tint, splotched with white spots. The seeds are of fine deep uniform brown, more sharply lenticular and rounded body than the others. The *S. sarmentosus* has fleshy, 12-inch long pod of uniform pale-brown color. The seeds are of a very pale gray-brown color.

The 3-foot blades of *Sansevieria guinensis* form the fiber plant. The long white fibers are heavy, and are excellent for making the strong ropes needed on shipboard.

Papuan or Guinea nutmegs from the *Argentea myristica* are about an inch in length, wrinkled and not plump. The *Myristica pseudar-*

gentea is about half the size. Both yield nutmegs of weak odor; the mace is more scraggy and thin; likewise of poor quality.

Kamerun lies to the north of the Congo Free State. A sickly gray cheese of *dika* bread forms their staple bread fruit, and is made largely from the *Irvingia gabunensis.*

Strophanthus Tholloni is shown as a dark-brown fleshy pod a foot in length. The seeds are very much flattened. The natives make a monkey-relish, with these seeds as an important addition; the poor apes, a terrible pest in that country, monkey no more after eating a small amount of the prepared meal. The *Strophanthus gratus* reminds one much of a fat, bulging milkweed-pod; it is smooth and of a pale-brown tint. This is much used to prepare an arrow poison.

Kamerun copal in white tears of clear resin down to the unwashed brown chunks are shown. The species yielding this fossil has as yet not been determined.

Ceylon cinnamon quills, cardamoms and many spices grow in this country to perfection.

The entry port for German Ost-Afrika is the British dependency, the isle and city of Zanzibar. Zanzibar copal (gum animé) is of excellent quality; the various grades are shown in good samples; this copal is obtained from *Trachylobium verrucosum.*

Strophanthus Eminii Pax et Aschers comes in light-gray pods about a foot in length. *Strophanthus grandiflorus* furnishes very hairy seeds, broader and of paler tint than the *S. hispidus.* In looking through the glass cases, it seems to us that the *S. hispidus* distinguishes itself from all the other seeds of these varieties by being of uniform length, about ¾ inch long, of smooth rounded body and of uniform deep-brown tint. The more highly considered *S. Kombé* is not shown in these collections.

On trees a very coarse thread-like lichen grows; this has a somewhat grayish tint when dried. This is the *Orcella montagnei* exported from Zanzibar in quite large quantities to Europe, where it is worked up for a kind of litmus dye.

In concluding, it might be well to say that the Germans have not spared expense to make all their exhibits presentable; elegant showcases are as essential at world shows as in sample-rooms and drug shops; the general impression will stick in the mind long after the exhibits of high intrinsic and educational value are forgotten.

THE COPPER TREATMENT OF WATER.

By Henry Kraemer.

The purification of water supplies containing pathogenic organisms being a subject of such vital importance, it seems to the writer that any method proposed for this purpose should receive careful consideration, not only at the hands of water engineers, health officials and physicians, but by all those who are in a position to test it, or to contribute information regarding it, or to foster a sentiment in favor of it, if found to be efficient. It was in this spirit that the writer undertook to carry on experiments for testing the efficiency of copper in reducing the number of micro-organisms in drinking water. The experiments were conducted in the microscopical laboratory of the Philadelphia College of Pharmacy, and I am indebted to Mr. John R. Rippetoe for assistance in the work. Before going further it should be stated that this communication is intended as a preliminary one.

During the years from 1876 to 1883 Prof. W. G. Farlow, of Harvard University, contributed some very interesting reports on the peculiar condition of the water supplied to the city of Boston, and showed in a paper published in *Science* (1883) the relations of certain forms of algæ to the disagreeable tastes and odors of some water supplies. It was, therefore, quite natural that Dr. George T. Moore, who was a student of Professor Farlow, and who has become so closely identified with this subject, should have become interested in it.

One of the earliest papers published by Dr. Moore along this line appeared in the American Journal of Pharmacy (January, 1900, p. 25), this being while he was still engaged in teaching at Dartmouth College.

In the Year-book of the U. S. Department of Agriculture for 1902 there is a paper by Dr. Moore, pathologist and algologist, in charge of the Laboratory of Plant Physiology, on "The Contamination of Public Water Supplies by Algæ," in which it is stated that some new experiments were inaugurated in the Department which promised to furnish another method of combating pollution in water caused by algæ. It is also stated that the experiments were successful in exterminating spirogyra in water-cress beds where it had done considerable damage.

The method used, however, was not published at that time; but after several years' experimenting it was given for the first time in a Bulletin of the Bureau of Plant Industry, published on May 7th of this year, an abstract of which appeared in the August number of this JOURNAL.

I think it can be said that at the present time there is not a doubt in the minds of engineers and others that the copper method proposed by Dr. Moore and Mr. Kellerman in this Bulletin is the only efficient one for removing algæ from water in reservoirs and in streams, and that this can be done without affecting the higher plants, as water-cress; or animal life, as fish, and so on.

While various explanations might be offered to show why such extremely minute quantities of copper sulphate as 1 part to 1,000,000 or even 50,000,000 parts of water is sufficient to kill the unicellular and filamentous algæ, and yet not affect multicellular plants, whose cells are as delicate in structure as those of the algæ, it seems to me that this is in a measure due to the fact that in the algæ the entire individual is comprised in a single cell, which performs all the vegetative as well as reproductive functions, and being entirely surrounded by the water containing the copper sulphate, all the life processes of the plant are affected, there being no way for it to distribute the solution to other cells, and thus by a dilution minimize the toxic action of the copper. Or if some of the cells in the multicellular plant are destroyed or injured by exposure to the solution, others are formed to take their place from the more or less deep-seated meristematic cells. It is true that the idiosyncrasies in these organisms should also be borne in mind, some of them being more resistant than others.

If the explanation be a valid one, it is reasonable to suppose that this principle of action would apply to other unicellular organisms, as the bacteria; and, indeed, Dr. Moore has shown that a solution of copper sulphate, 1 part to 100,000, is sufficient to destroy typhoid and cholera organisms in from three to four hours.

It was to be expected that the proposal of a method for the purification of water supplies, involving the use of copper sulphate, would arouse considerable discussion. In the first place, the question would arise as to the poisonous effects of the copper on man. Secondly, a question would arise to capitalists and others, who are investing large sums of money in filtration plants, as to whether

their investments and their labor extending over some years might not be entirely lost by the introduction of this comparatively simple and inexpensive mode of water purification.

The question of the danger from the use of copper sulphate in the manner set forth, has been shown by Dr. Moore to be practically without foundation, it being consumed in much larger quantities in certain foods at a single meal than would be obtained from a much larger quantity of water than would be consumed in a single day.

It may not be amiss to refer to Cushny's "Pharmacology and Therapeutics" in this connection, the work having been published in 1899, and the statements showing the peculiar behavior of copper being prophetic in a measure. He states that while it is comparatively harmless to man, yet it is exceedingly toxic to micro-organisms and intestinal parasites. Cushny says:

"Small quantities of copper may be taken for indefinite periods without any symptoms being induced, so that so far as man is concerned the general action of copper is unknown. . . . . On the other hand, copper is a deadly poison to several of the lower plants. Thus, traces of copper added to the water in which they live, destroy some of the simpler algæ, and Naegeli asserts that 1 part of copper in 1,000,000,000 parts of water is sufficient to kill these plants. . . . . Locke found that the traces of copper contained in water distilled in copper vessels were sufficient to destroy tubifex (one of the annelid worms) and tadpoles, while Bucholtz states that the development of bacteria is stopped by a solution of copper sulphate under 1 per cent. in strength. Copper thus seems to have a very powerful poisonous action on certain living forms and to be harmless to others, and the subject deserves further investigation. It is possible that it may prove to act prejudicially to some human parasites, and it is certainly less dangerous to man than many other remedies used as parasiticides and disinfectants."

The influence of the copper method in retarding the establishment of filtration plants would scarcely be any, it being proposed, as clearly stated by Dr. Moore, to apply this method to the purification of water containing pathogenic organisms, only as an emergency proceeding or as a supplementary measure, as when there are leaks in the filter or the filter is inefficient for any other reason, or when there is no filtration system. Notwithstanding the copper sulphate treatment, filtration would still be necessary for the removal of the excess of suspended matter from water supplies. While it is true that there are chemical methods of sedimentation, nothing practicable on a large scale has as yet been suggested.

In testing the value of copper sulphate for reducing the number

of micro-organisms in water, we used solutions having respectively the strengths of 1 part of copper sulphate to 100,000 parts of water, and of 1 part of copper sulphate to 1,000,000 parts of water; tap water was used after it was allowed to run about five minutes, and the solution was kept at room temperature for forty-eight hours. In this time there was a reduction of the total number of organisms in the first instance of 99 per cent. and in the second of 90 per cent.

The experiments which we are conducting are in the main, however, with colloidal copper, the reasons for which need not be stated. For this work my original intention was to use copper vessels; but finding that I would have to wait some time to have these made, those on the market being tin-lined, I decided to use strips of copper foil instead. The ordinary methods for the bacteriological examination of water were followed, Heyden's nutrient agar being used so as to obtain the growth of the maximum number of organisms. The mode of preparing this medium and its advantages are described by Dr. Robin in the March number of this JOURNAL. Ordinary sheet copper in thin pieces was used, these being about 15 centimeters square for each 1,000 c.c. of water, and being cleaned each time with a little powdered pumice. In some of the earlier experiments ordinary tap water was used (as much as 2,000 c.c. being experimented with), and it was found that from 85 to 97 per cent. of all the organisms were destroyed. In these experiments, as in those above mentioned, it is understood that if any typhoid and colon organisms were present, they would have been among the first to be destroyed.

The systematic study of the organisms which persist as well as those which were killed, is being continued, and will be reported on later. In order to satisfy myself that both colon and typhoid organisms are completely destroyed by the presence of copper foil, another series of experiments was made, using pure cultures of typhoid and of colon bacilli, which were allowed to develop from eighteen to twenty four hours in bouillon. Two 3-millimeter loops were added to 200 c.c. of water under three different conditions, control experiments being conducted at the same time. These were as follows: (1) Filtered tap water, which, after treatment with potassium permanganate, was distilled two or three times, the apparatus being constructed entirely of glass; (2) tap water which was filtered; and (3) ordinary tap water. All three were sterilized in an auto-

clave at 110 degrees for thirty minutes. After adding the cultures the water was kept at a temperature of 35° to 37° C., and plates were made at the end of four, eight, twenty-four and forty-eight hours, respectively. The plates were maintained at the same temperature and the organisms counted at the end of two days in the case of *B. coli* and of five days in the case of *B. typhosus*. The results are given in the following tables:

TABLE I.—EXPERIMENTS WITH *Bacillus coli*.

	Water *without* Copper Foil.			Water *with* Copper Foil.		
	Triple Distilled Water.	Filtered Tap Water.	Tap Water.	Triple Distilled Water.	Filtered Water.	Tap Water.
Plates made at time of adding culture	7,746	11,246	8,283	8,866	4,410	6,790
Plates made at end of four hours	7,655	5,075	7,665	No Organisms	No Organisms	No Organisms
Plates made at end of eight hours	7,735	3,115	7,000	"	"	"
Plates made at end of twenty-four hours	1,000,000	1,000,000	1,500,000	"	"	"
Plates made at end of forty-eight hours	1,200,000	1,600,000	2,000,000	"	"	"

TABLE II.—EXPERIMENTS WITH *Bacillus typhosus*.

	Water *without* Copper Foil.		Water *with* Copper Foil.		
	Triple Distilled Water.	Tap Water.	Triple Distilled Water.	Filtered Water.	Tap Water.
Plates made at time of adding culture	3,740	3,675	3,986	127	1,400
Plates made at end of four hours	2,835	3,815	No Organisms	No Organisms	No Organisms
Plates made at end of eight hours	3,850	1,995	" "	" "	" "
Plates made at end of twenty-four hours	3,750	1,435	" "	" "	" "
Plates made at end of forty-eight hours	3,815	1,540	" "	" "	" "

From the experiments thus far conducted the following conclusions may be drawn:

(1) The intestinal bacteria, like colon and typhoid, are completely destroyed by placing clear copper foil in the water containing them.

(2) The effects of colloidal copper and copper sulphate in the

purification of drinking water are in a quantitative sense much like filtration, only the organisms are completely destroyed.

(3) Pending the introduction of the copper treatment of water on a large scale the householder may avail himself of a method for the purification of drinking water by the use of strips of copper foil about 3½ inches square to each quart of water, this being allowed to stand over night, or from six to eight hours, at the ordinary temperature, and then drawn off or the copper removed.

CORRESPONDENCE.

THE PURIFICATION OF WATER BY MEANS OF COPPER.

The toxic influence of even very minute quantities of colloidal copper and of copper sulphate on certain micro-organisms having been pretty well established (see pp. 553, 574), the only other question of importance that arises in connection with their use for the purification of water supplies containing pathogenic organisms and algæ, is the one as to their effects on man. Inasmuch as this phase of the question is dependent upon physicians and pharmacologists for its elucidation, the editor of this JOURNAL has asked several members of the medical profession to discuss it.

It is to the credit of the medical profession that while some of those asked to contribute to this discussion have more or less positive convictions on the subject, others have been frank to say that their observations and experience in this line of investigation have not been sufficient to warrant them in giving an opinion at this time. One pharmacologist writes: "As I understand the purification method, the quantities of copper remaining in solution are so extremely small that they would scarcely be harmful."

Another eminent pharmacologist writes that when he was consulted by a city official to give an opinion as to whether one part of copper in 1,000,000 parts of water would be harmful, he replied that "assuming for purposes of argument that the copper remains in solution, and is not deposited or rendered insoluble, this small quantity could not be harmful to our citizens, even if they drank such water for a few days, since our ordinary food, as bread, meat, etc., all contain from two to three parts in the million. Some tissues, like the liver, contain as high as thirty parts in the million."

Up to the time of going to press replies were also received from Dr. Hare, Professor of Materia Medica and Therapeutics in the Jefferson Medical College, and from Dr. Holland, Dean and Professor of Medical Chemistry and Toxicology in Jefferson Medical College. Their replies are as follows:

My Dear Professor Kraemer:

In reply to your note let me state that small doses of copper exercise, so far as is known, a stimulant effect upon nutritional processes. I do not think that we have any information in regard to the infinitesimal quantities which are present in water when treated by the copper method, but it is incredible that they could exercise any deleterious influence. Certainly the improbable deleterious influence of infinitesimal quantities of copper when compared to the certain evil influence of micro-organisms amounts to nothing.

Very truly yours, H. A. HARE.

PHILADELPHIA, November 14, 1904.

Mr. Henry Kraemer, Editor of AMERICAN JOURNAL OF PHARMACY.

DEAR SIR:—In his paper on purification of water by copper I think that Dr. Moore shows conclusively that water supplies can be freed of pathogenic bacteria and algæ promptly, cheaply and efficiently by that means. The question remaining to be answered is, can this purification be done with entire safety to those drinking the water?

Until comparatively recent times it has been thought that the slow introduction of minute doses of copper was injurious to the tissues by causing such pathological changes as are known to be due to certain other metallic poisons, such as lead, arsenic and mercury. But Bernatzic[1] has proven that to produce toxic phenomena with copper salts it must be given freely and intentionally, and even then the subject spontaneously recovers when the administration ceases. When a student of medicine I was made aware of the harmlessness of copper sulphate in small doses. Quinine was very expensive then, and in the dispensary practice of a malarious region some cheaper substitute was needed. Hundreds of cases were treated with a combination of the sulphates of cinchonine, iron and copper. About 1/8 of a grain of sulphate of copper was given

[1] Encyc. d. ges. Heilkunde.

several times daily in this routine prescription for a tonic and anti-periodic.

I do not remember that any untoward symptoms developed, though they were not unexpected, as the books then taught that copper salts were irritants. So they are, but only in doses much larger than 1/8 of a grain. We saw no cumulative effects. Lehmann[1] and his pupils found that a man could take 1 to 2 grains of copper as sulphate and acetate daily in peas and beans divided into two meals without effect.

The highest sanitary authorities[2] appointed to investigate this matter have reported that "copper in the amounts found in canned goods is not capable of injury to health."

Metallic copper is not a poison. Surgeons have used copper wire for suturing wounds without noticing local irritation; children swallow copper pennies daily without injury to the digestive tract. As copper is present in almost all our food, it is not surprising to learn that each of us takes daily about 1 milligram of copper,[3] and that it is found regularly in our tissues. I see no reason to fear copper if the amounts never exceed the small proportion stated by Dr. Moore as entirely adequate for the purification of water supplies.

J. W. HOLLAND.

PHILADELPHIA, November 15, 1904.

PROGRESS IN PHARMACY.

A QUARTERLY REVIEW OF SOME OF THE RECENT LITERATURE RELATING TO PHARMACY AND MATERIA MEDICA.

By M. I. WILBERT,
Apothecary at the German Hospital, Philadelphia.

The closing year has been one of exceptional importance to the progress of pharmacy, along professional lines. Among the more interesting events that must contribute to this advance, we may enumerate: the enactment of the pre-requisite law by the State of New York; the union of the College of Pharmacy of the City of New York with Columbia University; the union of the

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[1] *Münch. Med. Wochenschr.*, 1891.

[2] Pasteur, Poggiale and Brouardel in *Annals d'Hyg.*, 1880.

[3] Blyth: "Poisons—Effects and Detection."

Maryland College of Pharmacy with the University of Maryland; the inauguration of an Association of State Boards of Pharmacy, at the recent meeting of the A.Ph.A. at Kansas City; the admission of pharmacists as members of the Section of Pharmacology of the American Medical Association. In addition to these several important events, there is also to be noted a continued increase in the feeling of mutual respect and regard, among members of the profession or calling, that is so essential to the making of any degree of progress in a professional way. Strange as it may seem, this particular feeling of mutual regard has been developed most successfully in connection with recent efforts to improve commercial conditions, and was particularly evident at the *sixth annual meeting of the National Association of Retail Druggists*, held in St. Louis, Mo., from October 10th to 14th, inclusive. This convention is said to have been the largest national gathering of retail pharmacists ever held in this country.

While the business meetings of this association were confined entirely to the consideration of commercial problems, the meeting of the various members, in a social way, coupled with the very unique educational features of the Louisiana Purchase Exposition, must necessarily have been of additional advantage to the pharmacists who were fortunate enough to be able to attend.

Of the Louisiana Purchase Exposition as an educational feature, it will not be necessary to do more than call attention again to the series of interesting descriptive articles that have appeared in this JOURNAL during the past months.

Among the more interesting happenings in the domain of abstract science the most important, probably, is the more general acceptance of what is usually referred to as *The New Theory of Matter*. One of the more popular expositions of this new theory was given by the Right Hon. A. J. Balfour, the Prime Minister of Great Britain, in his address, as president, before the British Association for the Advancement of Science. (PHAR. JOUR., August, 1904, page 297.) He says: "To-day there are those who regard gross matter, the matter of everyday experience, as the mere appearance of which electricity is the physical basis, who think that the elementary atom of the chemist, itself far beyond the limits of direct perception, is but a connected system of monads or subatoms which are not electrified matter, but electricity itself; that these systems

differ in the number of monad which they contain, in their arrangement and in their motion relative to each other and to the ether. That on these differences, and on these differences alone, depend the various qualities of what have hitherto been regarded as indivisible and elementary atoms; and that while in most cases these atomic systems may maintain their equilibrium for periods which, compared with such astronomical processes as the cooling of the sun may seem almost eternal, they are not less obedient to the law of change than the everlasting heavens themselves."

The more general acceptance of this new theory of matter, whether it prove to be true or false, marks a distinct step forward into the realms of the unknown that will, in the very near future, result in practical explanations of many of the hitherto unsatisfactorily explained physical phenomena.

The Unification of Potent Medicaments.—According to a recently published report (*Schweiz. Woch. f. Chem. u. Phar.*, 1904, page 539), the following governments have adopted the recommendations of the International Conference at Brussels, held 1902, without reserve: Belgium, Bulgaria, Denmark, France, Greece, Holland, Hungary, Italy, Norway, Portugal, Roumania, Russia, Spain, and Switzerland. The following have adopted the recommendations, with slight, but unimportant, provisions: Austria, Sweden and Great Britain.

The German Empire, whose representatives, it will be remembered, were not authorized to sign the protocol, has but recently (1900) published a revision of its pharmacopœia, and does not think the necessary changes of sufficient general importance to be introduced at this time, but has signified its willingness to adopt them in detail at its next revision.

In the United States the Pharmacopœia is revised by an independent committee of revision, not in any way connected with the government. This committee has not, so far as known, signified its intentions regarding the proposed unification of potent medicaments.

Swiss Pharmacopœia.—At a recent session of the Swiss Pharmacopœia Revision Commission several important general principles were finally adopted. After considerable discussion it was adopted to use the so-called practical (O–16) standard table of atomic weights in preference to the hydrogen standard.

The recommendations of the Brussels Convention for the unification of potent remedies were unanimously adopted.

To obviate any possible conflict with manufacturers or owners of patents on synthetic chemicals, it was proposed to omit the publication of trade names of patented or registered preparations as synonyms, but to include instead the following phrase: "The above described substance is chemically identical with that known as ——." It was also agreed to retain the names of authors of plant species; to designate the allowable ash of organic drugs, and to give the solubility of chemicals in as nearly as possible exact figures.

The seventy-sixth annual meeting of the German Naturalists and Physicians was held in Breslau from the 18th to 24th of September, and was, as usual, well attended. The meetings of the section on Pharmacy and Pharmacognosy were held in the hall of the Pharmaceutical Institute, and were presided over by Professor Gademer, the present director of the Institute.

Among the papers presented was one on "Matico Oil and Matico Camphor," by Professor Thoms, of Steglitz, who reported on the examination of a sample of matico oil that had been distilled from genuine matico leaves derived from Piper Angustifolium Ruiz et Pav. This oil on standing separated out a mass of crystals that on closer examination proved to be identical with asaron, the total was estimated as being in the neighborhood of 10 per cent. Former samples of oil of matico that had been examined contained apiol; this did not. Other physical characteristics of the oil were also quite different in this particular specimen. (*Süd. Deut. Apoth. Zeit'g*, 1904, page 678.)

German Opium.—Professor Thoms, in another paper, reviewed the experiments that had been made to produce opium in Germany, and then gave some interesting details of an experiment that he had conducted during the past summer. From white-seed poppy he was able to obtain an average of 1·27 grams of air-dry opium from 100 poppy heads; this opium was found to contain 6·6 per cent. of morphine corresponding very closely to what Biltz had found in 1829 (6·85 per cent.). From these figures it would require 80,000 poppy heads, or the double scarification of 40,000, for 1 kilo of opium. (*Phar. Zeit.*, September, 1904, page 812.)

Tin Plague or Tin Disease.—Dr. Hamburger called attention to

the fact that at low temperatures pure tin has the property of being changed to a peculiar modification of the metal—a dull gray powder. This change may also take place at ordinary temperatures if the tin has been brought in contact, infected as it were, with some of this powder. (*Phar. Zeit.*, 1904, page 814.)

The German Association for the Abolition of Quackery held an exhibition in connection with the meeting of the German naturalists and physicians that was intended to demonstrate how widespread and general the illegal practice of medicine is even in paternal Germany. This exhibition demonstrated, primarily, how difficult it will be to abolish, or even to prevent, the spread of quackery among the general public. (*Phar. Zeit.*, 1904, page 828.)

The prevailing tendency to overvalue the new and strange at the expense of the old and tried was the subject of an address by Sir Dyce Duckworth before the British Medical Association, who particularly deprecates the reckless administration of new drugs in place of well-tried and generally recognized standard remedies. (*Jour. Am. Med. Assoc.*, 1904, page 268.)

Proposed Reform in the Nomenclature of Synthetic Chemicals.—Golaz-Vevey (*Schweiz. Woch. f. Chem. u. Phar.*, 1904, page 566) calls attention to the fact that pharmacists are frequently directed to dispense preparations about which they know absolutely nothing more than the fanciful name ending in al, en, ic, in or ol. These names usually consist of (1) some arbitrary abbreviation of the descriptive chemical title; (2) some real or imaginary reference to the possible therapeutic uses of the remedy; or (3) some fanciful and usually far-fetched discovery of the manufacturer.

To reduce, to some degree at least, the abuses that must necessarily arise, it is proposed that pharmaceutical and medical societies demand that manufacturers furnish information on (*a*) the commercial as well as the exact chemical constitution of the preparation; (*b*) reliable tests for identity; (*c*) melting and boiling points; (*d*) solubility; (*e*) special incompatibility; (*f*) dose and therapeutic action; (*g*) necessary precautions that are to be observed in keeping the preparation.

If this really necessary information were forthcoming in all cases, new preparations might be dispensed and used with some prospect of a more rational advance in therapeutics.

Pharmaceutical Nomenclature.—American Medicine (October, 1904,

page 698) in calling attention to the need of generally acceptable non-trade-marked names for new drugs, speaks of the confusion existing in connection with the active principle of the suprarenal gland. "In the case of this substance, indeed, we are badly off, as the most appropriate name, 'Epinephrin,' which was given by Abel to this substance before any one had either isolated it or obtained it in any reasonable degree of purity, would not be recognized by the pharmacist to whom a prescription would be taken as applying to any of the products placed at his disposal by manufacturers, for each house has its own name, and claims superiority for the substance or combination of substances it designates by this name. It is not only possible, but probable, that there may be differences in these products—some essential, some non-essential. If so, there is all the more reason why some disinterested scientific body should determine and make known wherein such differences consist, and their chemic, physiologic and therapeutic importance. If the physician is to use pharmaceutic products usefully and skilfully, he must have definite and exact information concerning them; he must be sure that his patient gets what he prescribes, and he must not be led astray by unfounded similarities or differences in the naming of the agents he uses."

Camphor production in the far-away island of Formosa is not without its attending risks and dangers. The *Chemist and Druggist* (September, 1904, page 433), quoting from a paper by Sir John Keane, in *Blackwood's Magazine* for August, says: "The trees are felled and the camphor distilled from them chiefly by the Hakkas, who are civilized natives. But living in those mountains are many tribes of irreconcilable aborigines, who resent and, to the best of their power, resist the advance of their uninvited civilizers. For centuries it has been the custom of these savages to adorn their homes with the heads of their enemies, and when they have fixed on a head they want, they will lie in wait for its owner for days until they catch him. The camphor workers, who live in isolated parties, are well armed, but in the district visited by Sir John Keane forty heads had been lost in the previous nine months."

Green Cardamoms are simply the ordinary cardamoms dried in the air instead of being stove dried and sulphur bleached, in the usual method. The principal virtue of the green cardamom is said to be that it is much sweeter and stronger in flavor than the bleached

quality; while the prices at present are higher, the cost of production is less. The use to which green cardamoms are ultimately put is still more or less shrouded in mystery; but it appears that the demand for this variety was first created by the discovery made by the German sausage makers, who found that the better and stronger flavoring was got from the less finished article. (*Chem. and Drug.*, September, 1904, page 444.)

Nux Vomica.—The *Chemist and Druggist* (September, 1904, page 452) gives an abstract from an article published in the *Calcutta Capital* describing in detail the sources and methods of collecting this drug. Nux vomica is included among the general items of the minor forest products of India, and the right to collect is yearly sold to the highest bidder.

The nux vomica tree has an imposing appearance, bearing in the autumn clusters of greenish or yellow fruits, according to their maturity. The fruits are the size of an apple and contain a soft pulp, in which are embedded numerous round flattened seeds of a grayish-green color. The first quality of seed is obtained by collecting the fruits, washing out the seeds and drying them in the sun. The more inferior qualities of the drug usually consist of seeds gathered from under the trees, which have been rejected by the birds and monkeys, who eat freely of the pulp when ripe. Cochin enjoys a large trade in nux vomica, as the dry sub-mountainous tracts of the Travancore Hills afford seeds of good appearance and quality.

Rhubarb.—Prof. A. Tschirch, who has recently made an exhaustive comparative study of the different varieties of rhubarb, concludes that practically all of the known plants yielding rhubarb are to be classed in one or the other of three varieties, *Rheum Palmatum*, *Rheum Officinale* and *Rheum Collinianum*. From the fact that commercial Chinese rhubarb usually consists of a mixture of several varieties, some of which do not show any of the structural characteristics noted in the three varieties enumerated above, Tschirch concludes that much of it is derived from some still unknown plant. The chemical examination of the specimens grown in the botanical gardens at Berne, Switzerland, shows that there is considerable variation in the emodin content of the different varieties of rhubarb. Commercial Chinese rhubarb contains as high as 4 per cent. of emodin, while the best of that grown at Berne, derived from rheum

palmatum, gave but 2·8 per cent., the drug obtained from Rheum officinale 2 per cent., and Rheum collinianum 1·8 per cent. It will readily be seen that Rheum palmatum is the only variety that at all approximates Chinese rhubarb in strength, and Tschirch therefore strongly recommends the raising of this variety alone for medicinal purposes. From a recent trade report by Cæsar and Loretz, Halle a. d. S., it appears that there are at least three distinct types of Chinese rhubarb:

(1) Shensi rhubarb; this occurs in full, flat or round pieces, having a bright red color, not fibrous, with a distinctive, mild and not disagreeable, odor and a slightly aromatic bitter taste. Shensi or shansi rhubarb is considered the more valuable variety, and always commands a much higher price than either of the others.

(2) Canton rhubarb; this usually consists of round or flattish round pieces that have a tough, fibrous and more sponge-like structure and pale red color. Canton rhubarb has a distinctly empyreumatic odor and a distinctly bitter and peculiarly astringent taste.

(3) Shanghai rhubarb; flat, usually thinner pieces, partially fibrous, tough and usually of a firmer and a denser structure, yellowish red color, more distinctly empyreumatic odor and a peculiarly disagreeable and persistently bitter mucilaginous taste. (*Süd. Deut. Apoth. Zeit.*, 1904, page 590.)

Refractive Index of Clove Oil.—W. H. Simmons believes that there can be no doubt that the refractive index of clove oil is an important and useful factor, indicating as it does the approximate content of eugenol. It is not safe to base an opinion on the refractive index alone, particularly in cases in which the genuineness of the sample cannot be guaranteed. (*Chem. News*, through PHAR. JOUR., 1904, page 450.)

Detection of Powdered Gum Acacia in Powdered Tragacanth.—E. Payet finds that tragacanth does not, like acacia, contain an active oxydase, which acts on guaiacol in aqueous solution, in the presence of hydrogen peroxide. He proposes to take advantage of this fact in the following test: If a 1–30 solution of the suspected gum in cold water is mixed with an equal volume of a 1 per cent. guiacol solution in water, and a drop of hydrogen peroxide added, the mixture, if acacia be present, will soon become brown, but if the tragacanth be pure, remain unchanged. (*Phar. Jour.*, 1904, page 453, from *Repertoire de Phar.*)

Presence of Formaldehyde in Smoke.—A. Trillat finds that formaldehyde is invariably present in the products of combustion and smoke of organic materials, such as wood, paper, cellulose and tobacco. In some cases as much as 1–1·000 of the material, even simple hydrocarbons, like benzol, toluene and xylene, give appreciable quantities. He concludes, therefore, that formaldehyde is a constant and normal constituent of the combustion products. (*Compt. Rend.*, through *Phar. Jour.*, September, 1904, page 378.)

Poisoning by Wood Alcohol.—Dr. Frank Buller, of Montreal, and Dr. Casey A. Wood, of Chicago, presented a lengthy report on the cases of death and blindness from wood alcohol, Columbian spirits and other methylated preparations before the section on ophthalmology at the meeting of the American Medical Association in Atlantic City last June. This report has been published (*Jour. Am. Med. Assoc.*, October 1, 8, 15, 22 and 28), and contains much that should be of interest to the pharmacist.

Among the commmercial forms of methyl alcohol the authors enumerate as crude productions: wood alcohol, wood spirit, pyroligneous spirit, wood naphtha and methylated spirits. Of the deodorized products, Columbian spirits, Colonial spirits, Union spirits, Eagle spirits, green wood spirits and standard wood spirits. These several products have been and are being recommended to be used for bathing, burning and cleaning. In all of these uses ample opportunity is afforded for absorption of the poison.

The authors conclude that methyl or wood alcohol in any of its forms is a dangerous poison, menacing both life and eyesight. To this date at least 153 cases of blindness and no less than 122 deaths have resulted from its use.

Almatein is a combination of hæmatoxylin with formaldehyde and is an odorless powder, soluble in alcohol and in glycerin. It is being recommended as a substitute for iodoform. (*Phar. Cent. Halle*, 1904, page 794.)

Cyclogallipharic Acid is the name given by Kunz-Krause and Schelle to a new acid which they have isolated from gall-nuts. The acid crystallizes in prisms, and is insoluble in water, but soluble in most organic solvents. Its formula is $C_{21}H_{36}O_3$. It is non-basic, yields a mono-acetyl derivative and gives a blue precipitate with ferric chloride. (*Chem. and Drug.*, September, page 546.)

Digalen.—This is said to be a soluble digitoxin, obtained by a

complicated process, not given or described, from prime digitalis leaves. Digalen is a white amorphous substance chemically identified with crystalline digitoxin. The dose of digalen is from 0·003 to 0·012. (*Phar. Zeit.*, 1904, page 716.)

Eucaine Lactate occurs as a white non-hygroscopic powder, readily soluble in water and also in alcohol. The aqueous solution has a slightly alkaline reaction. It is recommended as a local anæsthetic, and is used in from 2 to 5 per cent. solutions for the eye and for dental practice, and in from 10 to 15 per cent. solutions for the nose and ear. For infiltration a 0·1 per cent. solution in 1 or 0·8 per cent. solution of sodium chloride is recommended. (*Phar. Zeit.*, September, 1904, page 684.)

Euporphin is a methyl bromide compound of apomorphine, and is being recommended as an improvement on the latter drug. Euporphin is readily soluble in water and in alcohol, but only slightly soluble in ether, chloroform, benzol or benzine. It occurs as white, or yellowish white, crystalline scales that are gradually changed to a brownish color under the influence of moisture, air and light. Maximum single dose, 0·02; maximum daily dose, 0·06. (*Apoth. Zeit*, September, 1904, page 720.)

Glycosal (mono-salicylic acid glycerin ester) is a white crystalline powder, melting at 76° C., and soluble in cold water to the extent of about 1 per cent. It is readily soluble in hot water or alcohol, less freely soluble in ether or chloroform and readily miscible with glycerin. Glycosal has been recommended for internal as well as external use as a substitute for salicylic acid in cases of rheumatism. It is given in doses of from 0·50 to 1·00 three or four times a day. (*Viertel Jahresschr. f. Prac. Phar.*, 1904, page 213.)

Isoform (p. Iod-anisol) is being recommended as an antiseptic and deodorant. P. iod-anisol is obtained by oxydizing iod-anisol, and occurs as silvery scales that are but slightly soluble in water. They are more soluble in hot water or in diluted acetic acid; insoluble in alcohol or in ether. At a temperature of 225 degrees isoform is decomposed with explosive violence. For various reasons it is being marketed only in mixtures with calcium phosphate or as a paste with glycerin. (*Phar. Zeit.*, 1904, page 842.)

Marsitriol (ferric glycero-arsenate), a yellow amorphous powder, said to be an efficient preparation of arsenic, is given in doses of from 0 05 to 0·20 per day. (*Rev. Ed. Phar.*, 1904, page 849.)

Styracol (the cinnamic acid ester of guaiacol) is recommended on account of its being a comparatively non-toxic preparation of guaiacol. It is odorless and tasteless, and, in addition to its possible use in the treatment of tuberculosis, has been used in intestinal colic and summer diarrhoea. The dose is given as being 1·00 three or four times a day. (*Süd. Deut. Apoth. Zeit.*, 1904, page 626.)

REVIEWS AND BIBLIOGRAPHICAL NOTICES.

A COMPENDIUM OF CHEMISTRY, INCLUDING GENERAL, INORGANIC AND ORGANIC CHEMISTRY. By Dr. Carl Arnold, authorized translation from the eleventh German edition by John A. Mandel, Sc.D., Professor of Chemistry in the University and Bellevue Hospital Medical College. New York: John Wiley & Sons. 1904. Small 8vo, 627 pages. $3.25

This is the first American edition of the well-known "Repetitorium der Chemie" of Arnold, which has gone through numerous editions in Germany. The translator says: "The eleventh and last edition contains concise but clear statements of the most important theories and facts, especially in the recently developed domain of physical chemistry, as well as a classified review of the most important inorganic and organic compounds, including statements of the constitution and derivation of these substances."

In the division of the subject as given in the title, we find 95 pages taken up with general chemistry, 200 with inorganic chemistry, both non-metallic and metallic, and 277 with organic chemistry. While this relatively large proportion of space given to general or theoretical chemistry makes the book very satisfactory to an advanced chemical student for review or for the practising chemist as a compend to turn to, it prevents its use with the beginner, as the theory is all massed together at the outset before the descriptive part, some acquaintance with the experimental side of chemistry being needed for the proper understanding of this mass of theory. However, the theory is very well stated. After discussing under the heading "Stoichiometry," the subject of atoms, molecules, symbols, formulas, valence, and properties of elements, the author proceeds to take up, under the heading "Chemical Affinity," the subject of chemical mechanics (chemical dynamics and chemical statics), thermo-chemistry, electro-chemistry and photo-chemistry.

These are presented in accordance with the most modern views of physical chemistry, and give the reader an excellent idea of the great advances of this new branch of science. The classification of reactions according to the conditions of equilibrium indicated, and the application of the phase rule to determine the several systems is very clearly and intelligently stated; the ionic theory and its applications in the explanation of the phenomena of electrolysis is equally well stated, and some of its applications of importance for physiological chemistry indicated. Practical applications of these theories are also indicated, as in connection with the discussion of the electromotive series where the author explains "a knowledge of the electromotive series is of practical importance, since in all cases where objects of metal (alloys, combinations of metals in contact, metals with mechanically or galvanically prepared metallic coatings) are exposed to the action of the elements an opportunity is afforded for the formation of short circuited galvanic couples, as a result of which the metal with the highest solution tension dissolves, but the other remains intact. Galvanized iron is, therefore, not so strongly oxidized at points where the zinc covering has been injured as if it were not galvanized, while tinned iron on an injury to the tin coating oxidizes (rusts) more readily than it would if it were not tinned, because the iron has a greater solution tension than tin and a lower solution tension than zinc."

The portion devoted to inorganic chemistry is in the main well written, and in every way up-to-date in its statements, but it suffers in places from too great condensation, made necessary by the wide scope of the book. The analytical reactions are specially noted after each metal in a section on the detection of its compounds. The translator has made a blunder in the section on Iron (page 280), by translating the German steinkohlen by the word anthracite. In speaking of the blast furnace he says: "Anthracite cannot be used directly, but must first be converted into coke." It is needless to say that coke is made from bituminous coal and not from anthracite.

The classification and general treatment of the organic section is very satisfactory, and serves to give one an excellent survey of the field of organic compounds and the relationship existing there.

The book is provided with a very full index, and has an enormous amount of information compressed in its 627 pages.

S. P. SADTLER.

INDEX

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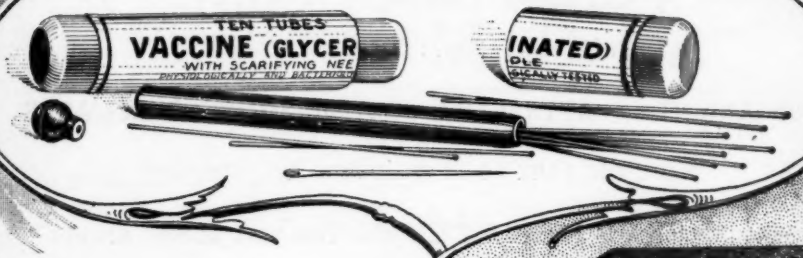

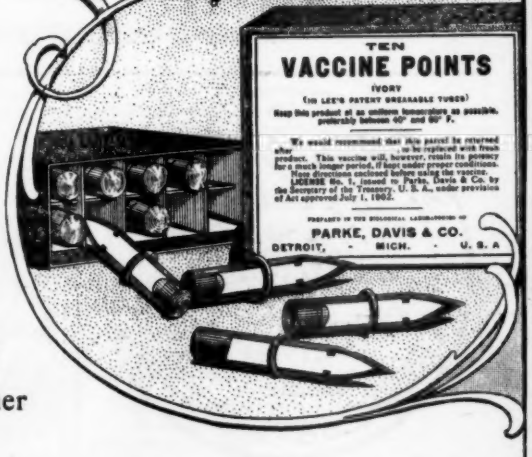

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